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CLAIMS

1. (Original) A method for detecting precursors to compressor stall/surge, the method comprising:

monitoring at least one compressor parameter to obtain raw data representative of said at least one compressor parameter;

pre-processing said raw data using a frequency demodulator to produce pre-processed data;

post-processing said pre-processed data using a Kalman filter to obtain stall precursors.

2. (Original) The method of claim 1 wherein said monitoring comprises monitoring at least one of static pressure of gasses flowing through the compressor, dynamic pressure of gasses flowing through the compressor, velocity of gasses flowing through the compressor, and forces and vibrations exerted on a casing of the compressor.

3. (Original) The method of claim 2 wherein said monitoring comprises monitoring dynamic pressure at least one location within said compressor.

4. (Original) The method of claim 3 wherein said monitoring comprises monitoring dynamic pressure at a plurality of locations within said compressor.

5. (Original) A method for detecting precursors to compressor stall/surge, the method comprising:

monitoring at least one compressor parameter to obtain raw data representative of said at least one compressor parameter;

pre-processing said raw data using a frequency demodulator to produce pre-processed data, said pre-processing being at least partially performed in the digital domain.

post-processing said pre-processed data using a Kalman filter to obtain stall precursors.

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6. (Original) The method of claim 5 further comprising:

sampling and digitizing signals representing said at least one compressor parameter to obtain time-series analyzed data.

7. (Original) The method of claim 6 wherein said pre-processing comprises:

pre-filtering time-series analyzed data obtained from said at least one compressor parameter to reject undesirable signals;

frequency demodulating the filtered signal to produce a demodulated signal having an amplitude corresponding to the instantaneous frequency of a locally dominant component of the input signal, and

low pass filtering the demodulated signal to reduce noise interference.

8. (Original) The method of claim 7 wherein said pre-filtering comprises band-pass filtering said time-series analyzed data, said band pass filter rejecting all signals outside a band of frequency spectrum.

9. (Original) The method of claim 8 wherein said band is centered on the tip-passage frequency of compressor blades within said compressor.

10. (Original) The method of claim 7 wherein said frequency demodulating is performed such that said locally dominant component is the tip-passage frequency of compressor blades within said compressor.

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11. (Original) A method for detecting precursors to compressor stall/surge, the method comprising:

monitoring at least one compressor parameter to obtain raw data representative of said at least one compressor parameter;

pre-processing said raw data using a frequency demodulator to produce pre-processed data, said preprocessing being performed at least partially in the analog domain;

post-processing said pre-processed data using a Kalman filter to obtain stall precursors.

12. (Original) The method of claim 11 wherein said pre-processing comprises:

pre-filtering time-series signals representing said at least one compressor parameter to reject undesirable signals;

frequency demodulating the filtered signal to produce a demodulated signal having an amplitude corresponding to the instantaneous frequency of a locally dominant component of the input signal, and

low pass filtering the demodulated signal to reduce noise interference to produce preprocessed signals.

13. (Original) The method of claim 12 wherein said pre-filtering comprises band-pass filtering said time-series analyzed data, said band pass filter rejecting all signals outside a band of frequency spectrum.

14. (Original) The method of claim 13 wherein said band is centered on the tip-passage frequency of compressor blades within said compressor.

15. (Original) The method of claim 12 wherein said frequency demodulating is performed such that said locally dominant component is the tip-passage frequency of compressor blades within said compressor.

16. (Original) The method of claim 12 further comprising sampling and digitizing said preprocessed signals to produce time-series preprocessed data.

17. (Original) The method of claim 1 wherein the Kalman filter computes a filtered estimate of locally dominant components of the preprocessed data.

18. (Original) The method of claim 17 further comprising computing a standard deviation of innovations of said Kalman filter to determine a stall precursor signal.

19. (Original) The method of claim 18 further comprising comparing said stall precursor signal to a threshold.

20. (Original) The method of claim 19 further comprising controlling said compressor to take corrective action when said precursor signal exceeds said threshold.

21. (Original) The method of claim 20 wherein said corrective action is performed iteratively until the precursor signal is below said threshold.

22. (Original) The method of claim 20 wherein said corrective action comprises reducing the loading on said compressor.

23. (Original) A system for detecting precursors to compressor stall/surge comprising:

at least one sensor positioned at said compressor to monitor at least one compressor parameter, said at least one sensor outputting raw data representative of said at least one compressor parameter;

a frequency demodulator receiving said raw data, demodulating said raw data, and producing demodulated data;

a Kalman filter obtaining stall precursors from said demodulated data.

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24. (Original) The system of claim 23 wherein said at least one compressor parameter comprises one or more of a static pressure sensor sensing a static pressure of the gasses flowing through the compressor, a dynamic pressure sensor sensing a dynamic pressure of the gasses flowing through the compressor; a velocity sensor sensing a velocity of the gasses flowing through the compressor; and a forces and vibrations sensor sensing forces and vibrations exerted on a casing of said compressor.

25. (Original) The system of claim 23 further comprising a calibration system for sampling and digitizing output from said at least one sensor to obtain time-series analyzed raw data, said frequency demodulator receiving said time-series analyzed raw data.

26. (Original) The system of claim 23 further comprising a pre-filter to reject undesirable signals from said raw data prior to being input into said frequency demodulator.

27. (Original) The system of claim 26 wherein said pre-filter comprises a band-pass filter centered on a locally dominant component of the input signal.

28. (Original) The system of claim 27 wherein said locally dominant component is a tip-passage frequency of said compressor.

29. (Original) The system of claim 23 wherein said demodulator operates on said raw data in the analog domain.

30. (Original) The system of claim 23 wherein said demodulator operates on said raw data in the digital domain.

31. (Original) The system of claim 23 further comprising a low-pass filter filtering the demodulated data to reduce noise interference prior to being input into the Kalman filter.

32. (Original) The system of claim 23 further comprising a stall precursor measure system computing a standard deviation of innovations of said Kalman filter to determine a stall precursor signal.